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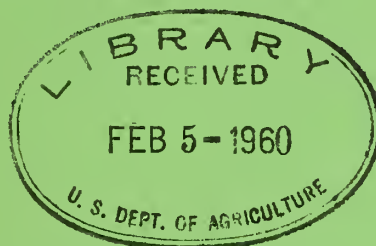
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CONSERVATION *in the* KLINKITAT, USING GRASSES *and* LEGUMES

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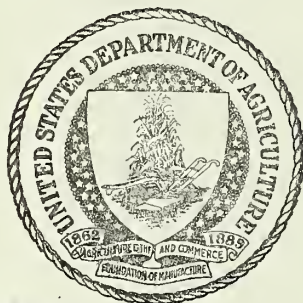


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CONSERVATION IN THE KLICKITAT, USING GRASSES AND LEGUMES

When the Klickitat Valley was first settled it had a reputation for abundant bunchgrass and fertile soils. Through the years, by repeated removal of crops and ever increasing erosion, fertility has been reduced to a very low level. Sheet erosion is serious, organic matter is low, and the soil puddles and bakes badly. More than 50 percent of the top soil has been lost over most of the valley.

Control of erosion at the present fertility level is not enough. It is necessary to rebuild the structure and physical condition of the soil with grass and grass roots. Fertility and nitrogen content of the soil must be built up with legumes. Conservation becomes more than saving what is left; it is building back toward the original high organic and fertility levels of the virgin soil. It is saving and using the water where it falls.

The agriculture of the community is changing. Farmers are turning from a wheat-summer fallow system to a market hay crop. Alfalfa hay stands are left in for many years. A rotation system using alfalfa-grass and grain is a more desirable system of conservation farming than either all grain or all hay. Grass must be planted with the alfalfa for two principal reasons: (1) To give greater protection against the loss of topsoil by erosion, and (2) to improve the structure of the soil.

To help solve the problems of building back, the Goldendale Nursery was established by the Soil Conservation Service in co-operation with the State College of Washington in 1936. It was planted on the W. F. Hornibrook farm about 4 miles south of Goldendale, Washington. It is part of a system of nurseries of the Soil Conservation Service, U. S. Department of Agriculture. Initial tests of thousands of grasses are made at the central nursery at Pullman, Washington. The most promising plants are then tested in nurseries like Goldendale. Plants are observed and measured for their conservation value and local adaptation. This local nursery was established to provide needed information for conservation farming in the Goldendale community. The results have application to adjacent areas.

Soils and Erosion

Soil and climatic conditions at this nursery are representative of the Central Klickitat Soil Conservation District, with the exceptions of the Swale Creek Flat and the Goodnoe Hills. The location of the nursery plot and the weather stations is indicated on the district map.

Most of the upland soils in the district are Goldendale loam or a very similar type. The soils were formed in place by decomposition of basalt. They vary from 2 to 6 feet in depth to bedrock. In its virgin condition the soil supported a luxuriant growth of grasses and native legumes. Pioneers reminisce of the "nigger wool"--the rich, dark brown color--and the ease of working these soils in the early days.

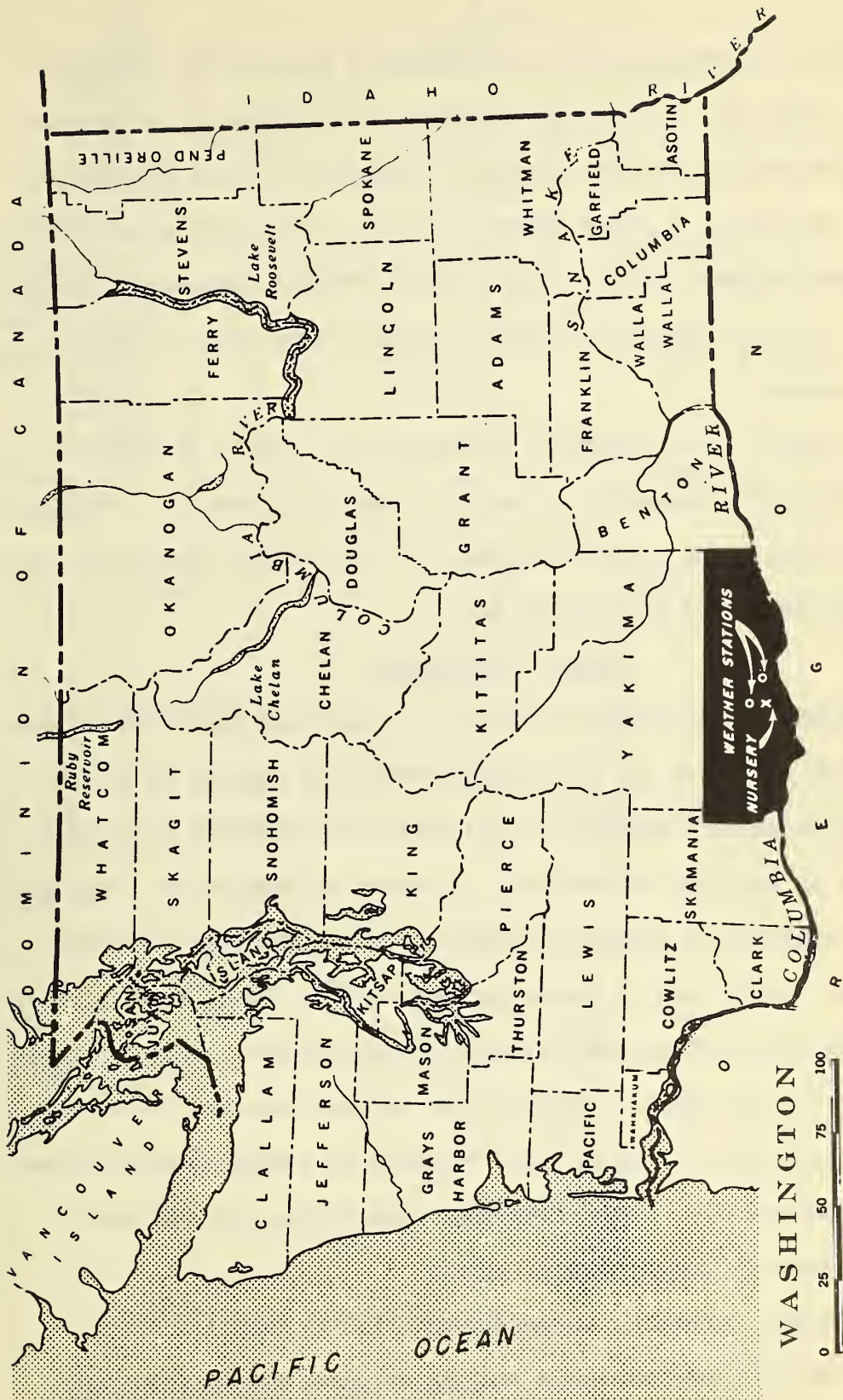


FIGURE 1.- Location of the Goldendale Outlying Nursery and the 2 weather stations in the vicinity.

Recent investigations by the Washington Agricultural Experiment Stations indicate a 1.0 percent organic matter content of Goldendale loam fields which have been cropped to wheat in a fallow system for the past 65 years. A field recently plowed out of alfalfa has nearly 2.0 percent organic matter. Soil samples from the unplowed roadsides indicate that the original level of organic matter varied from 1.5 to 2.3 percent.

The soil at the nursery is Goldendale loam, 24 to 36 inches deep to bedrock. It is mapped as 6M and is capability Class II. More than half the topsoil has been eroded away. It had raised only grain since it was broken out of grass about 1885.

Climate and Erosion

Rainfall is low--about 16 inches per year--and elevation is low--about 1,600 feet--for the alfalfa-grain types of farming which the community supports. Rainfall varies within the district from about 22 inches at Hartland to less than 14 inches at Rock Creek. From year to year, rainfall is erratic, ranging at Goldendale from less than 12 inches to more than 24 inches per year within the 10 years of this study. Monthly distribution of precipitation is very erratic, especially during the winter. Rainfall has varied from none in January 1947 to quantities exceeding 5 and 6 inches in a single month between October and February. These extremely high monthly intensities of rainfall occur in about 1 out of 3 years.

The annual rainfall and the distribution by months for the period 1936-1950 for Goldendale and the Ferguson Ranch, short distances from the nursery, are shown in Figure 2.

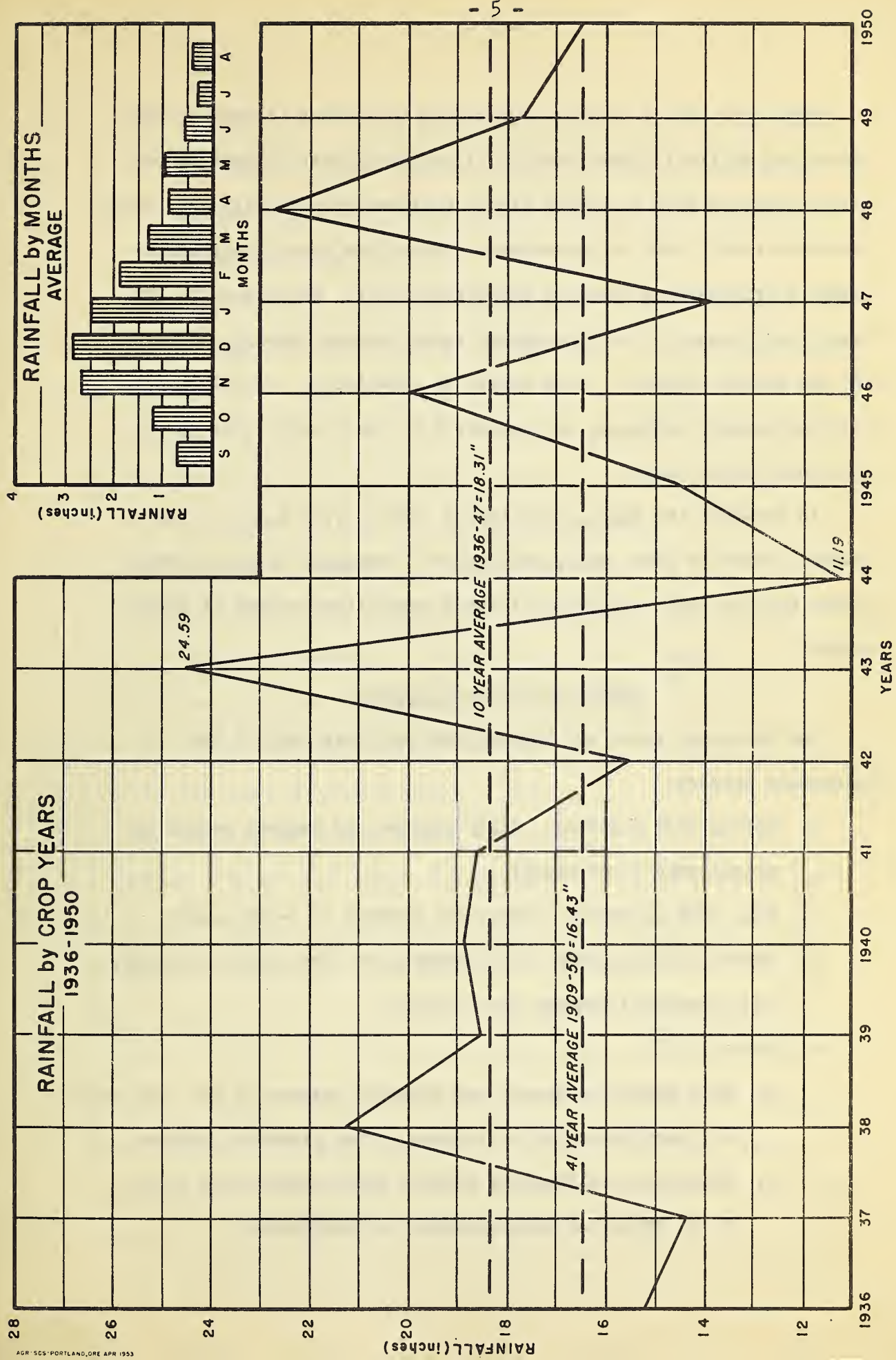


FIGURE 2.-Distribution of rainfall at Goldendale, Washington.

Soil must have a cover of vegetation to protect it from erosion during the critical winter period. An added climatic hazard is the accumulation of snow on frozen ground followed by warm rain or a warm "chinook" wind. Most of the erosion occurs from these heavy winter rains or from melting snows on unprotected soil. Shallow soils and "scab rock" areas do not have enough water-holding capacity to hold all the winter rainfall. Some runoff is inevitable. Diversion systems and grassed waterways are necessary to carry this water safely over lower lying lands.

In one-half the years, less than 1 inch of rain falls in the 3-month period of June, July, and August. Perennial soil-protecting plants must be able to survive or evade these long periods of summer drought.

Legume and Grass Plantings

The following grass and legume plantings were made at the Goldendale nursery:

1. Spring 1936 planting. Sixty grasses and legumes seeded in triplicated 3-row blocks.
2. Fall 1936 planting. Fifty-four grasses in 3-row blocks.
3. Spring 1937 planting. One hundred and five native, foreign, and introduced grasses and legumes.
4. Spring 1938.
 - a. Rows seeded to annual and biennial legumes in the 1936 nursery were replanted to legumes or new perennial grasses.
 - b. Fourteen alfalfa-grass mixture plots were seeded on the H. G. McPherson farm northwest of Goldendale.

5. Spring 1948. A cooperative grass-alfalfa variety plot nursery was established on the Harold Hill farm. This nursery was supplemented by several fertilizer trials on alfalfa on adjacent farms, 1947-1949.

All the plantings listed above, except the plots, were made with 24-inch row spacings and cultivated until 1940. The rows were plowed out in 1949.

Each of the species and strains in these plantings was evaluated for conservation use on the following bases:

1. Protection of soil surface against erosion.
2. Ability to improve soil structure.
3. Ability to grow with alfalfa in mixtures.
4. Ability to maintain a stand for at least 6 years.
5. Production of forage.
6. Ability to compete with weeds.
7. The ease of establishing a stand.
8. Ability to produce a good seed crop.

Table 1 shows the amount of ground cover and feed produced from the nursery planted in the spring of 1936. Thirty-two grasses and 28 legumes were planted. The same kind of information for the fall 1936 nursery is shown in Table 2.¹ This nursery had 51 grasses and 4 legumes in it. For each of these two nurseries data were taken for at least 4 years. From this information it was possible to determine which grasses and legumes were best for use in this area. Also, it was possible to divide both grasses and legumes into groups according to the way they could best be used to protect and improve the soil.

¹Yields in Tables 1 and 2 are based on average of 3 replications.

The groups were: (1) Grasses for mixture with alfalfa including (a) long-lived bunchgrasses, (b) understory grasses, (c) sodgrasses, and (d) those grasses that provide ground cover and improve the soil but do not show in the harvest hay; (2) those that can be used in sweet-clover-grass mixtures; (3) those that will have specialized uses; and (4) those that were not believed to have any use in this area.

Two other nursery row plantings were made, one in 1937 and one in 1938, but these were failures because of beating rains that crusted the surface. Only 9 out of 105 accessions produced stands better than 50 percent under these conditions. No tables are included.

The alfalfa-grass plots established in 1938 on the H. G. McPherson farm northwest of Goldendale were harvested for yield in 1941 and 1942. The average annual production was 1-1/2 tons of hay per acre with 16 percent grass. The production data and percentage grass are summarized in Appendix Table 3. These data offer proof that crested wheatgrass, beardless wheatgrass, or big bluegrass will maintain 15 to 20 percent grass in an alfalfa mixture.

The 1948 plots included the following grasses, each with Ladak alfalfa: hard fescue; sheep fescue; Canada bluegrass; Sherman big bluegrass; and Whitmar, crested, intermediate, and pubescent wheatgrass. The seeding season was very favorable, and excellent stands of all mixtures were obtained. Production data were taken in 1949 and 1950. Hay yields again averaged 1-1/2 tons per acre. Grass percentages ranged from a trace to 50 percent of the mixture. Sheep and hard fescue gave excellent ground cover but were hardly present in the hay. Intermediate and pubescent wheat mixtures with alfalfa contained between 50 and

60 percent grass. Whitmar wheatgrass, Sherman big bluegrass, sheep fescue, and crested wheatgrass were the only grasses to remain productive through seasons of normal to below normal rainfall.

Many field mixture seedings were made on farms during 1936 to 1938 using alfalfa, smooth brome, slender wheatgrass, and tall oatgrass. These grasses gradually disappeared so that in a few years the fields had the appearance of pure stands of alfalfa. It was soon realized that these grasses were not adapted, but that crested wheatgrass and Sherman big bluegrass were maintaining stands in alfalfa mixtures. Stands of the latter group have maintained their balance with alfalfa over a period of 10 years. Cheatgrass invasion of stands is prevented by a vigorous, early growing grass in the mixtures.

Grasses for Mixture with Alfalfa

Long-lived bunchgrasses. Grasses for mixture with alfalfa must be long-lived and maintain production. The six best grasses are listed in the following table.

Production in pounds per acre from two plantings of long-lived bunchgrasses made at Goldendale in 1936.

Species	Spring Planting	Fall Planting	Average per year
	5-year total 1937-41	4-year total 1938-41	
Sherman big bluegrass	5943*	6714	1406
Beardless wheatgrass	5324	5415	1193
Crested wheatgrass	5955	4611	1174
Bluebunch wheatgrass	4890	4332	1025
Orchardgrass	3508	4081	843
Tall oatgrass	4005	2814	758

*Four-year total.

Sherman big bluegrass and Whitmar wheatgrass are varieties of grass from the native vegetation of the Northwest which were tested and selected by Soil Conservation Service Nurseries and cooperating experiment stations. Certified seed of both is now commercially available. For mixture with alfalfa, either one of these grasses or crested wheatgrass is most desirable. Field plantings and field trials made on farms in the community bear this out. After 10 years, field plantings of alfalfa with any one of these three grasses are still producing good crops of alfalfa-grass mixture. The stands are good and provide an excellent ground cover.

Crested wheatgrass, Sherman big bluegrass, and Whitmar wheatgrass all reach the hay stage of maturity at about the same time as alfalfa. A short description of each grass follows.

Sherman big bluegrass is a native bunch-type bluegrass. It is outstanding for its early succulent spring growth, drought resistance, high yield, extensive root system, and compatibility in alfalfa-grass mixtures used for hay. It should be planted in alternate rows with alfalfa. Establishment is difficult and should be attempted only by those who have had previous experience with other grasses. Seedings should be made very early and very shallow on a clean, very firm seedbed. Use depth regulators. Grazing should not be permitted during the first two years of the life of this grass.

Crested wheatgrass is a drought and cold resistant grass which has been in common use in dryland areas for many years. One of the first plantings of crested wheatgrass in Goldendale was made by Harry Ferguson in the early 1920's. Seed is available and stands are easily established with alfalfa. Alfalfa-crested wheatgrass makes a palatable hay mixture, as demonstrated by feeding trials at Union, Oregon.

Whitmar wheatgrass is a leafy, native perennial dryland bunchgrass. It is slower to develop than crested wheatgrass but, after the first year, provides good ground cover. It produces a large amount of roots to improve soil structure and, when grown with alfalfa, an excellent hay is produced. It has few or no beards (awns).

Understory grasses. The vernal dominants (plants which make their growth in the early part of the season) and the fine-leaved fescues should be considered for planting with alfalfa. One of these grasses may be used to provide winter ground cover and root production to improve the physical condition of depleted soils.

Production from two plantings of grasses at Goldendale, Washington.

Species	Spring Planting	Fall Planting	Average per year
	4-year total 1938-41	4-year total 1938-41	

Vernal Dominants:

Sherman big bluegrass	5943	6714	1582
Nevada bluegrass	Not planted	2496	624
Sandberg bluegrass	940 (3 years)	1400	337
Bulbous bluegrass	530 (3 years)	850	197

Fine-leaved Fescues:

Chewings fescue	2824	3496	790
Idaho fescue	2655	2720	672
Sheep fescue	2619	1621	530

Sherman big bluegrass appears in both this group and the long-lived perennial bunchgrasses. In mixtures with alfalfa it contributes from 10 to 30 percent to the yield of the hay.

Bulbous bluegrass matures too early and makes very little root growth. It is especially undesirable in market hay because of its bleached appearance. It has a use for seeding on depleted range and pasture land that cannot be cultivated. Nevada bluegrass and Sandberg bluegrass have been erratic and seed is not commercially available.

In the fine-leaved fescue group, sheep fescue makes excellent ground cover and tremendous root growth and establishes rapidly from fall seeding into a young alfalfa stand. Most of the growth is basal

and contributes little to the harvested forage. It may be used in fields intended for market hay if grass content is objectionable. Seed is commercially available. Chewings fescue is less drought resistant than sheep fescue, and Idaho fescue is more difficult and slow to establish.

Sod Grass Performance. The sod grasses which might be used with alfalfa are listed below. Neither their forage yields nor their root development as measured at other nurseries compares with the long-lived bunchgrasses. However, they may be used for waterway and gully plantings. Smooth brome planted with alfalfa has proved short-lived on upland Goldendale loam.

Production from two plantings of sod-forming grasses
at Goldendale in 1936.

Species	Spring Planting 5-year total 1937-41	Fall Planting 4-year total 1938-41	Average per year
Western wheatgrass	3768	3441	801
Smooth brome	3846	2405	695
Beardless wild-rye	2560	2980	616

Pubescent wheatgrass	These grasses were planted in a later nursery and in plots where yields were taken. Pubescent wheatgrass is the only sod grass recommended for mixture with alfalfa.
Intermediate wheatgrass	

Alfalfa Varieties. Six alfalfa varieties were planted in 1936, and production was measured for 5 crop years. Average yields are given below and production by years is given in Table 2. Legumes other than alfalfa and sweetclover were tested, but yields were so low they were eliminated from further consideration.

<u>Variety</u>	<u>1937-41 Average 5-year yield</u>
Ladak	2516
Hardistan	2145
Grimm	2466
South Dakota Number 12	2080
Arizona common	2180
Washington common	2470

Differences because of variety were small, but Ladak, Grimm, and Washington common (local Goldendale-grown seed) were the best producers. In an alfalfa variety trial established on the Harold Hill farm in 1948, Ladak, Grimm, and Ranger were the highest producing varieties. A hardy northern alfalfa variety such as Ladak should be used.

In 1947 complete fertilizer trials were put on old alfalfa stands on the Linden, Trumbo, and Hill farms. The fertilizer trials were conducted in cooperation with Tom Jackson, in charge of outlying testing for the Washington Agricultural Experiment Stations, Agronomy Division. Trials included N, P, K, alone and in various combinations with boron, sulphur, manure, and gypsum. Trials were added to the Hornibrook farm in 1948. Results of all trials, 1947 through 1949, showed responses only to sulphur applied as such or in the form of gypsum. Increased hay yield ranged from 400 to 1,200 pounds per acre. On the basis of these trials, an

application of 200 pounds per acre of 18 percent sulphur gypsum is recommended every 2 years, or 200 pounds gypsum with 40 pounds sulphur every 4 years. Borax should be applied at 20 pounds per acre where deficiency symptoms are present.

The only other response was increased grass growth where nitrogen was applied. Yields were increased about 400 pounds per acre by stimulating the growth of bulbous bluegrass.

The very slow establishment of new seedings on most fields indicates a generally low organic matter level. Complete fertilizer trials were established prior to new alfalfa seedings. There was no response except where a heavy application of manure was plowed under with the wheat stubble the previous fall.

For successful establishment, new alfalfa-grass seedings must be established without a companion crop on land plowed the previous fall and worked to a firm, solid seedbed.

Recommended alfalfa-grass mixtures. Use crested wheatgrass, Sherman big bluegrass, or Whitmar wheatgrass in mixture with alfalfa. Pubescent wheatgrass, intermediate wheatgrass, and sheep fescue are promising grasses for mixture with alfalfa and may be used in field trials. Recommended mixtures and seeding rates are:

	<u>Pounds per acre</u>
1. Ladak or local alfalfa	5
Crested wheatgrass	6
2. Ladak or local alfalfa	5
Sherman big bluegrass	5
3. Ladak or local alfalfa	5
Whitmar wheatgrass	8

Grasses for Use with Sweetclover

This group includes those grasses which establish quickly, produce a high yield the second year, and then decline sharply in yield or die out. Some of the grasses in this group are adapted for use with sweetclover for either pasture or green manure the second year or with alfalfa in short rotations. The data for this group are summarized below.

Production in pounds per acre from two plantings of rapid-developing grasses made at Goldendale in 1936.

Species	Spring Planting 2-year total 1936-37	Fall Planting 2-year total 1937-38	Average per year
Mountain brome	3258	2728	1497
Blue wild-rye	3008	2952	1490
Canada wild-rye	3495	2159	1414
Slender wheatgrass	3020	1931	1238
Tall oatgrass	1934	1714	912
Timothy	1605	Not planted	802

Primar slender wheatgrass is a new, early maturing, leafy, disease-resistant, rapid-developing grass. It is specifically adapted for use in sweetclover-grass mixtures. In comparison with other slender wheatgrass strains, it is earlier in spring recovery, more productive in growth, and has coarser, more abundant leaves and stems. It is compatible with and has a growth rate corresponding to that of sweetclover. The slender wheatgrass used in these trials is a strain much inferior to the more recently developed Primar.

Bromar is an improved strain of mountain brome grass that is particularly well suited for use with sweetclover for pasture and green manure.

Sweetclover Varieties. The relative merits of eight sweetclover varieties were partially determined. Madrid, Spanish, and common yellow were the most productive and appear to be best adapted both for pasture and green manure. Subsequent seed plots and field trials have shown that it is possible to grow sweetclover seed in the Goldendale area. Madrid sweetclover is the only recommended improved variety available in quantity for conservation seedings.

Field planting trials indicate that the wild-rye grasses are not as well adapted as Primar or Bromar for planting with sweetclover.

Recommended mixtures for sweetclover-grass conservation plantings are:

	<u>Pounds per acre</u>
1. Madrid sweetclover	5
Primar slender wheatgrass	8
<u>or</u>	
2. Madrid sweetclover	5
Bromar mountain brome	10

Summary

1. One hundred and ninety-nine species and strains were tested in nursery rows for adaptation, production, and conservation value.
2. The best grasses for use with sweetclover are Primar slender wheatgrass or Bromar mountain brome.
3. The best adapted grasses for use with alfalfa for hay, erosion control, and soil building are crested wheatgrass, Sherman big bluegrass, or Whitmar wheatgrass. Sheep fescue is a valuable root-producing and erosion-control grass for use with alfalfa.
4. Pubescent wheatgrass is the most drought resistant, sod-forming grass for use with alfalfa.
5. Recommended mixtures:

	<u>Pounds per acre</u>
Alfalfa-grass*	
Ladak alfalfa	5
One of the following:	
Crested wheatgrass	6
Sherman big bluegrass	4
Whitmar wheatgrass	8
For erosion control in dry gullies:	
Sheep fescue	5
Pubescent wheatgrass**	5
Sweetclover-grass	
Madrid sweetclover	5
Bromar mountain brome	10
<u>or</u>	
Primar slender wheatgrass	8

*On deep soils and on the better sites alfalfa and intermediate wheatgrass can be used.

**The variety of pubescent wheatgrass that has been released in Washington and for which seed is available is Topar.



The Goldendale nursery established in 1936 on the W. F. Hornibrook farm four miles south of Goldendale, Washington.

May 1940 V. B. Hawk 40-68



Beardless wheatgrass in the foreground was superior to crested wheatgrass in the 1936 nursery plantings.

May 1940 V. B. Hawk 40-66



Alfalfa-grass plots seeded in the spring of 1938 on the H. G. McPherson farm northwest of Goldendale. Sherman big bluegrass is most prominent in this picture.
May 1941 V. B. Hawk 41-63



A close-up of a mixture which contained effective amounts of Sherman big bluegrass, beardless wheat, and Idaho fescue. These grasses all gave excellent ground cover.
May 1941 V. B. Hawk 41-62

Table 1. Stand and yield of vegetative cover, 1936 - 1941, of soil conserving plants which were seeded at Goldendale, Washington, in the spring of 1936.

Row No.	Species	Acc. No. P-	1936 Stand	Yield	1937 Stand	Yield	1938 Stand	Yield	1939 Stand	Yield	1940 Stand	Yield	1941 Stand	Yield	5-Yr. Total	Av. Yield 1937-41
1	Tall meadow oatgrass	3052	83	400	93	1534	92	1048	95	613	93	400	50	410	4005	801
2	Orchardgrass	3135	97	179	90	862	85	1239	97	447	93	430	85	530	3508	701
3	Beardless wheatgrass	2617	78	102	75	1212	82	1552	75	970	88	810	93	780	5324	1065
4	Bluebunch wheatgrass	2719	63	121	72	934	80	1556	70	860	88	760	92	780	4890	978
5	Crested wheatgrass	3137	99	*267	100	2420	95	1325	88	840	95	820	100	550	5955	1191
6	Fairway crested wheatgrass	3171	85	272	92	1881	90	1107	83	663	93	620	97	480	4751	950
7	Slender wheatgrass	3138	96	553	95	2467	93	971	Good	----	90	430	70	150	4018	
8	Western wheatgrass	2787	70	34	82	779	100	1029	Good	----	100	1380	100	580	3768	
9	Mountain brome	2133	100	646	100	2612	100	1751	100	470	98	460	85	530	5823	1164
10	Smooth brome	3053	93	159	95	2188	93	1003	Good	----	100	335	97	320	3846	
11	Canada wild-rye	2623	98	587	98	2908	97	1202	80	547	93	580	82	280	5517	1103
12	Beardless wild-rye	2599	2	----	4	81	57	889	45	650	60	500	90	440	2560	512
13	Blue wild-rye	2586	87	446	83	2562	82	1438	78	620	90	540	93	370	5530	1106
14	Hairy-scale Colorado wild-rye	3217	15	----	7	94	38	712	23	497	7	----	10	240	1543	
15	Reed canarygrass	3140	68	281	67	1469	78	1229	55	497	60	220	67	250	3665	733
16	Superior reed canary-grass	2368	37	107	17	1068	55	1447	27	803	42	900	50	400	4618	923
17	Perennial ryegrass	3162	100	998	97	1215	90	939	Poor	70	Dead				2224	
18	Timothy	3164	67	239	57	1366	85	1547	65	707	82	385	80	470	4475	895
19	Meadow fescue	3144	95	291	100	1638	93	1438	75	507	90	240	97	450	4273	855
20	Meadow fescue	3161	98	304	100	1495	95	1048	80	473	93	240	97	500	3756	751

Table 1. Continued

Row No.	Species	Acc. No.	1936	1937	1938	1939	1940	1941	5-Yr. Total	Av. Yield 1937-41
No.		P-	Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield
21	Idaho fescue	2717	0	---(1)	13	---	23	122	32	873
22	Sheep fescue	3167	0	---(1)	27	---	63	476	83	923
23	Chewings fescue	3150	8	---(1)	95	---	88	1211	93	703
24	Sherman big bluegrass	2716	1	---(1)	95	---	97	2790	100	1393
25	Nevada bluegrass	2579	1	---(1)	92	---	90	1937	100	1030
26	Canada bluegrass	3169	0	---(1)	5	---				
27	Canby bluegrass	3201	0	---(1)	85	---			97	810
28	Sandberg bluegrass	2731	0	---(1)	72	---			83	650
29	Bulbous bluegrass	2788	1	---(1)	33	---			88	440
30	Prairie junegrass	2648	0	---(1)	77	---	50	183	92	530
31	Sand dropseed	2746	0	X	50	X				
32	Indian ricegrass	2683	0	Reseed	60	X				
33	Ladak alfalfa	3051	100	325	97	1323	100	4092	90	1787
34	Hardistan alfalfa	3062	100	238	95	1274	82	3030	80	1383
35	Grimm alfalfa	3143	100	335	98	2018	83	3493	83	1630
36	So. Dakota 12 alfalfa	3160	100	436	98	1348	92	2994	92	1567
37	Arizona common alfalfa	3170	100	558	95	1549	98	3366	93	1477
38	Washington common alfalfa	3228	100	509	100	1664	100	3902	97	1873
39	Sainfoin	2808	92	111	82	1151	87	708	30	240
40	Spanish sweetclover	2825	100	708	97	4393	20	1034)	1937 Spring Planting	

Table 1. Continued

Row No.	Species	Acc. No. P-	1936 Stand	Yield	1937 Stand	Yield	1938 Stand	Yield	1939 Stand	Yield	1940 Stand	Yield	1941 Stand	Yield	5-Yr. Av. Yield 1937-41 Total
41	Tall white sweetclover	3145	99	437	100	3574	30	953) 1937 Spring Planting
42	Madrid sweetclover	3215	100	501	97	1821	80	2450							
43	Grundy County sweetclover	3172	100	563	95	1918		953							
44	Alpha 1 sweetclover	3139	100	625	98	1522	40	1279							
45	Common yellow sweetclover	3166	99	425	97	1821	80	1878) 1937 Spring Planting
46	Alborea sweetclover	3147	99	407	92	2552	20	980							
47	Alsike clover	3146	15	58	53	706	62	1084	20	510	0	----		2300	
48	Red clover	3165	78	286	78	764	67	1116	52	1023	0	----		2903	
49	Black medic	3141	98	262	93	1239	93	1370	28	213	0	----		2822	941(3)
50	Hubam annual sweet-clover	3159	97	1076	--	----									1076
51	Minsoy soybean	3131	99	757	--	----									
52	Hungarian vetch	3057	90	398	52	175	)							573
53	Hairy vetch	3059	99	781	68	700	)							1481
54	Purple vetch	3060	90	456	52	324	)							780
55	Common vetch	3058	85	233	60	257	)							490
56	Austrian winter pea	3061	97	697	78	741	)	1937 Spring Planting						1438
57	Canadian field pea	3168	50	453	28	716	)							1169
58	Kaiser field pea	3175	50	519	75	744	)							1263
59	Alaska field pea	3136	50	107	20	623	)							730
60	O'Rourke field pea	3227	50	543	55	----	)							543

(1) Reseeded in fall of 1936.

(2) Four-year averages.

(3) Three-year averages.

1076

2300 770(3)
 2903 968(3)
 2822 941(3)

573
 1481
 780
 490

1438
 1169
 1263
 730
 543

Table 2. Stand and yield of vegetative cover, 1937 - 1941, of soil conserving plants which were seeded at Goldendale, Washington, in the fall of 1936.

Row No.	Species	Acc. No. P-	1937		1938		1939		1940		1941		4-Yr. Total	Average 1938-41
			Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield		
1	Smooth brome	3053	100	579	100	1375	90	500	100	200	100	330	2405	601
2	Mountain brome	2133	90	537	100	2191	100	1070	90	530	80	570	4361	1090
3	Orchardgrass	3135			100	2191	100	940	100	270	100	680	4081	1020
4	Alta fescue	2827	100	333	100	1810	100	880	100	540	100	410	3640	910
5	Meadow fescue	3144	85	246	95	1293	95	500	90	150	25	150	2093	519
6	Sheep fescue	3167	25		30	231	50	670	50	240	75	480	1621	405
7	Idaho fescue	2717	85		80	150	80	1400	80	630	90	540	2720	680
8	Idaho fescue	2580	75		70	259	80	1210	70	440	80	730	2639	660
9	Chewings fescue	3361	90		95	776	100	1540	100	530	100	650	3496	874
10	Nevada bluegrass	2754	100		85	585	90	1020	85	780	90	460	2845	711
11	Sherman big bluegrass	2716	90	264	90	2600	100	2000	100	1010	95	840	6450	1612
12	Big bluegrass	2579	85	210	90	1511	90	1320	90	690	90	540	4061	1015
13	Nevada bluegrass	2646	100		95	885	100	750	100	560	100	300	2495	624
14	Canada bluegrass	3169	50		80	925	60	1070	80	490	90	520	3005	851
15	Skyline bluegrass	2743	75				90	610	90	Poor	75	680	1290	
16	Pine bluegrass	2588	100				100	750	90	Poor	100	300	1050	
17	Sandberg bluegrass	2731	100				100	880	90	Poor	100	520	1400	
18	Sandberg bluegrass	2714	100				90	610	90	Poor	100	270	880	
19	Canby bluegrass	3201	100				100	610	90	Poor	100	380	990	
20	Bulbous bluegrass	2788	100				100	690	100	Poor	80	160	850	
21	Crested wheatgrass	3137	100	444	95	1797	95	1010	100	800	100	560	4167	1042
22	Crested wheatgrass	3171	100	525	95	1470	95	730	100	690	100	580	3470	867
23	Siberian wheatgrass	22	75	225	60	817	60	1050	75	670	80	670	3207	802
24	Slender wheatgrass	3138	100	951	95	980		0	90	410	75	190	1580	395
25	Beardless wheatgrass	2617	100	369	90	1456	85	1480	90	480	90	1130	5046	1262

Table 2. Continued

Row No.	Species	Acc. No. P-	1937		1938		1939		1940		1941		4-Yr. Total	Average 1938-41
			Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield		
26	Bearless wheatgrass	2792	100	348	80	1320	70	1610	85	940	90	880	4750	1188
27	Bluebunch wheatgrass	2719	100	183	95	1239	85	1060	100	780	100	1070	4149	1037
28	Bluebunch wheatgrass	2615	100	357	90	1633	90	1220	95	990	100	940	4783	1196
29	Western wheatgrass	2787	90	108	85	681	85	1140	100	970	100	650	3441	860
30	Western wheatgrass	3066	90	195	65	517	70	1020	80	760	100	520	2817	704
31	Giant wild-rye	3335	100	162	75	544	70	670	80	610	90	460	2284	571
32	Canada wild-rye	2623	100	825	90	1334	85	820	90	460	50	220	2834	709
33	Blue wild-rye	2886	100	516	95	2436	80	880	100	630	95	440	4986	1246
34	Bearless wild-rye	2599	75	117	60	490	70	640	90	1160	100	690	2980	745
35	Bearless wild-rye	3393	75	90	40	191	20	290	50	420	80	290	1191	298
36	Meadow barley	2603	100	471	100	1375	95	480	95	40	25	140	2035	508
37	Bearded wheatgrass	1806	100	411	95	2300	75	880	75	220	25	160	3560	890
38	Big squirreltail	3360	50	57	70	1021	90	1220	75	1170	75	480	3891	973
39	Indian ricegrass	2683	25	6			5	Poor	10	110	5	80	196	----
40	Indian ricegrass	2373	50	18	20	163	15	240	10	120	10	160	683	----
41	Lemmon needlegrass	4707												----
42	Thurber needlegrass	4905												(1)
43	Needleandthread grass	3084	95	105	70	612	25	440	10	100	5	80	1232	308
44	Needleandthread grass	3356	90	51	20	340	20	590	10	220	10	220	1370	342
45	Green needlegrass	3085	100	159	45	721	25	750	75	730	80	420	2621	655
46	Sleepygrass	3211	100	273	75	517	40	340	25	200	5	110	1167	292
47	Williams needlegrass	2636	90	186	65	558	15	420	25	410	50	300	1688	422
48	Letterman needlegrass	2738	90	90	65	286	25	350	75	370	70	190	1196	299
49	Prairie junegrass	3078	60	---			10	Poor	5	Poor	10	190	190	----
50	Tall meadow oatgrass	3052	80	369	70	1375	85	500	50	270	25	300	2445	611

Table 2. Continued

Row No.	Species	Acc. No. P-	<u>1937</u> Stand Yield	<u>1938</u> Stand Yield	<u>1939</u> Stand Yield	<u>1940</u> Stand Yield	<u>1941</u> Stand Yield	4-Yr. Total	Average 1938-41		
51	Alfalfa (Ladak)	3051	100	513	Good	90	1060	90	2830	4403	
52	Alfalfa (Arizona)	3170	10	36	Poor	10	1200	10	1280	2516	(2)
53	Tree lupine	1775	0		Poor	1	Poor	Dead			(2)
54	Bighorn clover	4474	0		Poor	20	Poor	50	50	50	(2)
55	S. cereale X S. montanum	5701			Good	10	100	Dead		1880	(2)
56	S. cereale X S. montanum	4560			Good	5	55	Dead		1605	(2)
57	S. cereale X S. montanum	4560			Poor	2	0	Dead		300	(1)

(1) Planted in the fall of 1937.
(2) Planted in the spring of 1938.

Table 3. Yield in pounds per acre of alfalfa-grass mixtures---McPherson farm near Goldendale, Washington.
Planted April 27, 1938.

Plot No.	Components of Mixture	1940 ⁽¹⁾			1941		1942		2-Yr. Total	Average	Average % Grass
		Stand	Yield	%Grass	Stand	Yield	Stand	Yield			
1 - 8	Crested wheatgrass Bulbous bluegrass Alfalfa	E P F	700		G P G	2910	16	3115	17 6025	3013	16-1/2
2 - 9	Whitmar wheatgrass Sandberg bluegrass Alfalfa	E V.P. F	720		G P G	2810	16	3260	13 6070	3035	14-1/2
3 - 10	Crested wheatgrass Smooth brome Alfalfa	E F F	600		G G G	2610	13	3120	17 5730	2865	15
4 - 11	Crested wheatgrass Western wheatgrass Alfalfa	E P F	700		G F G	2990	12	3240	15 6230	3115	13-1/2
5 - 12	Whitmar wheatgrass Western wheatgrass Alfalfa	G F F	690		G F G	2720	16	3320	15 6040	3020	15-1/2
6 - 13	Crested wheatgrass Sherman big bluegrass Idaho fescue Alfalfa	G F P F	720		G G F G	3220	18	3220	25 6440	3220	21-1/2
7 - 14	Whitmar wheatgrass Sherman big bluegrass Idaho fescue Alfalfa	G F P F	855		G G F G	3020	22	3060	21 6080	3040	21-1/2

(1) No yields taken in 1940.

Table 4. Accessions tested at Goldendale Nursery and discarded as not suitable for conservation use or forage.

Species	Acc. No. P-	Reason for discard
Tall meadow oatgrass	3052	Not sufficiently drouth hardy and too short-lived for use with alfalfa.
Orchardgrass	3135	
Smooth brome	3053	
Meadow fescue	3144, 3161	
Creeping red fescue	3150	
Perennial ryegrass	3162	
Timothy	3164	
Alta fescue	2877	
Western wheatgrass	2787, 3066	Slow to establish, low production on upland soils.
Beardless wild-rye	2599, 3393	
Nevada bluegrass	2754, 2646	Not as good as Sherman big bluegrass.
Sandberg bluegrass	2731, 2714	
Canby bluegrass	3201	
June grass	2648	
Bulbous bluegrass	2788	Suitable for use on range land but undesirable in hay.
Canada wild-rye	2623	Not as good as Bromar mountain brome or Primar slender wheatgrass for use with sweetclover.
Blue wild-rye	2586	
Bulbous barley	305	
Bluebunch wheatgrass	2719, 2615	Not as good as beardless wheatgrass.
Fairway crested wheatgrass	3171	Not as good as standard crested wheatgrass.
Sand dropseed	2746	Not adapted.
Indian ricegrass	2683	
Meadow barley	2603	
Idaho fescue	2717	Slow to establish; not as good as sheep fescue.
Needlegrasses	--	Not as good as other grasses.
Alsike clover	3146	Not as good as sweetclover or alfalfa.
Red clover	3165	
Vetches		
Field peas		
Sainfoin	2808	

Table 5. Common names, scientific names, and accession numbers of species referred to in the text and tables.

Common Name	Scientific Name	Accession Number and Variety
		P-
Alfalfa	Medicago sativa	3051 Ladak
		3062 Hardistan
		3143 Grimm
		3160 So. Dak. 12
		3170 Arizona common
		3228 Washington common
Alsike clover	Trifolium hybridum	3146
Bearded wheatgrass	Agropyron subsecundum	1806
Beardless wheatgrass	Agropyron inerme	2617
		2792
		3537 Whitmar
Beardless wild-rye	Elymus triticoides	2599
		3393
Big bluegrass	Poa ampla	2579
		2716 Sherman
Big squirreltail	Sitanion jubatum	3360
Bighead clover	Trifolium macrocephalum	4474
Black medic	Medicago lupulina	3141
Bluebunch wheatgrass	Agropyron spicatum	2719
		2615
Blue wild-rye	Elymus glaucus	2586
Bulbous bluegrass	Poa bulbosa	2788
Canada bluegrass	Poa compressa	3169
Canada wild-rye	Elymus canadensis	2623
Canby bluegrass	Poa canbyi	3201
Chewings fescue	Festuca rubra	
	commutata	3150
		3361
Crested wheatgrass	Agropyron cristatum	3137
		3171 Fairway
Giant wild-rye	Elymus condensatus	3335
Green needlegrass	Stipa viridula	3085
Hairyscale Colorado wild-rye	Elymus ambiguus strigosus	3217

Table 5. Continued

Common Name	Scientific Name	Accession Number and Variety
		P=
Idaho fescue	<i>Festuca idahoensis</i>	2580
		2717
Indian ricegrass	<i>Oryzopsis hymenoides</i>	2373
		2683
Intermediate wheatgrass	<i>Agropyron intermedium</i>	2327
Lemmon needlegrass	<i>Stipa lemmoni</i>	4707
Letterman needlegrass	<i>Stipa lettermani</i>	2738
Meadow barley	<i>Hordeum nodosum</i>	2603
Meadow fescue	<i>Festuca elatior</i>	3144
		3161
Mountain bromegrass	<i>Bromus marginatus</i>	2133
		3368 Bromar
		3972
Needleandthread	<i>Stipa comata</i>	3084
		3356
Nevada bluegrass	<i>Poa nevadensis</i>	2579
		2646
		2754
Orchardgrass	<i>Dactylis glomerata</i>	3135
Pea, field	<i>Pisum arvense</i>	3061 Austrian winter
		3136 Alaska field
		3168 Canadian field
		3175 Kaiser field
		3227 O'Rourke field
Perennial ryegrass	<i>Lolium perenne</i>	3162
Pine bluegrass	<i>Poa scabrella</i>	2588
Prairie junegrass	<i>Koeleria cristata</i>	2648
		3078
Pubescent wheatgrass	<i>Agropyron trichophorum</i>	41
Red clover	<i>Trifolium pratense</i>	3165
Reed canarygrass	<i>Phalaris arundinacea</i>	2368 Superior
		3140
Rye hybrid	<i>Secale cereale</i> X <i>Secale montanum</i>	4560
		5701
Sainfoin	<i>Onobrychis sativa</i>	2808
Sand dropseed	<i>Sporobolus cryptandrus</i>	2746

